

CLAIMS

1. A semiconductor device, comprising:

an active layer, to which group I elements, group III elements, group IV elements, group V elements, or group VII elements are added, and which is made of a semiconductor containing (i) polycrystalline ZnO or polycrystalline  $Mg_xZn_{1-x}O$ , (ii) amorphous ZnO or amorphous  $Mg_xZn_{1-x}O$ , or (iii) either (a) mixture of the polycrystalline ZnO and the amorphous ZnO or (b) mixture of the polycrystalline  $Mg_xZn_{1-x}O$  and the amorphous  $Mg_xZn_{1-x}O$ ; and

a blocking member for blocking the active layer from an atmosphere such that the atmosphere never influences a region, in which a movable charge moves, of the active layer.

2. The semiconductor device as set forth in claim 1, wherein:

each of the elements corresponds to nitrogen, phosphorus, arsenic, or stibium; or the elements correspond to not less than two of nitrogen, phosphorus, arsenic, and stibium.

3. The semiconductor device as set forth in claim 1, wherein:

the elements corresponds to (i) hydrogen and (ii) nitrogen, phosphorus, arsenic, stibium, or not less than two of nitrogen, phosphorus, arsenic, and stibium.

4. The semiconductor device as set forth in claim 3, wherein:

the active layer is formed under an atmosphere containing (i) one or more of nitrogen, dinitrogen monoxide, nitrogen monoxide, and nitrogen dioxide, and (ii) one or more of water vapor, hydrogen peroxide, and ammonia.

5. A method for manufacturing the semiconductor device as set forth in claim 3, comprising the step of:

forming the active layer under an atmosphere containing (i) one or more of nitrogen, dinitrogen monoxide, nitrogen monoxide, and nitrogen dioxide, and (ii) one or more of water vapor, hydrogen peroxide, and ammonia.

6. The semiconductor device as set forth any one of claims 1 through 4, wherein:

the blocking member is made up of different blocking layers.

7. The semiconductor device as set forth in claim 6,  
wherein:

at least one of the blocking layers is made of SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, AlN, MgO, Ta<sub>2</sub>O<sub>5</sub>, TiO<sub>2</sub>, ZrO<sub>2</sub>, stab-ZrO<sub>2</sub>, CeO<sub>2</sub>, K<sub>2</sub>O, Li<sub>2</sub>O, Na<sub>2</sub>O, Rb<sub>2</sub>O, In<sub>2</sub>O<sub>3</sub>, La<sub>2</sub>O<sub>3</sub>, Sc<sub>2</sub>O<sub>3</sub>, Y<sub>2</sub>O<sub>3</sub>, KNbO<sub>3</sub>, KTaO<sub>3</sub>, BaTiO<sub>3</sub>, CaSnO<sub>3</sub>, CaZrO<sub>3</sub>, CdSnO<sub>3</sub>, SrHfO<sub>3</sub>, SrSnO<sub>3</sub>, SrTiO<sub>3</sub>, YScO<sub>3</sub>, CaHfO<sub>3</sub>, MgCeO<sub>3</sub>, SrCeO<sub>3</sub>, BaCeO<sub>3</sub>, SrZrO<sub>3</sub>, BaZrO<sub>3</sub>, LiGaO<sub>2</sub>, a mixed crystal of LiGaO<sub>2</sub> such as (Li<sub>1-(x+y)</sub>Na<sub>x</sub>K<sub>y</sub>)(Ga<sub>1-z</sub>Al<sub>z</sub>)O<sub>2</sub>, or a solid solution containing at least two of them.

8. The semiconductor device as set forth in claim 7,  
wherein:

a blocking layer constituting the blocking layers is made of SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, AlN, MgO, Ta<sub>2</sub>O<sub>5</sub>, TiO<sub>2</sub>, ZrO<sub>2</sub>, stab-ZrO<sub>2</sub>, CeO<sub>2</sub>, K<sub>2</sub>O, Li<sub>2</sub>O, Na<sub>2</sub>O, Rb<sub>2</sub>O, In<sub>2</sub>O<sub>3</sub>, La<sub>2</sub>O<sub>3</sub>, Sc<sub>2</sub>O<sub>3</sub>, Y<sub>2</sub>O<sub>3</sub>, KNbO<sub>3</sub>, KTaO<sub>3</sub>, BaTiO<sub>3</sub>, CaSnO<sub>3</sub>, CaZrO<sub>3</sub>, CdSnO<sub>3</sub>, SrHfO<sub>3</sub>, SrSnO<sub>3</sub>, SrTiO<sub>3</sub>, YScO<sub>3</sub>, CaHfO<sub>3</sub>, MgCeO<sub>3</sub>, SrCeO<sub>3</sub>, BaCeO<sub>3</sub>, SrZrO<sub>3</sub>, BaZrO<sub>3</sub>, LiGaO<sub>2</sub>, a mixed crystal of LiGaO<sub>2</sub> such as (Li<sub>1-(x+y)</sub>Na<sub>x</sub>K<sub>y</sub>)(Ga<sub>1-z</sub>Al<sub>z</sub>)O<sub>2</sub>, or a solid solution containing at least two of them, and

said blocking layer is so provided as to meet the active layer separately from (i) each of two electrodes serving as blocking layers and connected to the active layer, and (ii) an insulating layer, which serves as a

blocking layer and meets the active layer, for insulating the active layer from a control electrode for controlling move of a movable electric charge in the active layer.

9. The semiconductor device as set forth in claim 6, wherein:

at least one of the blocking layers is made of resin.

10. The semiconductor device as set forth in claim 9, wherein:

a blocking layer constituting the blocking layers is made of resin, and

said blocking layer is so provided as to meet the active layer separately from (i) each of two electrodes serving as blocking layers and connected to the active layer, and (ii) an insulating layer, which serves as a blocking layer and meets the active layer, for insulating the active layer from a control electrode for controlling move of a movable electric charge in the active layer.

11. The semiconductor device as set forth in claim 6, further comprising:

a gate electrode for controlling move of a movable electric charge in the active layer;

a gate insulating layer, which serves as a block

layer, for insulating the active layer from the gate electrode;

a source electrode connected to the active layer;

and

a drain electrode connected to the active layer,

wherein:

at least one of the blocking layers is made of  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{AlN}$ ,  $\text{MgO}$ ,  $\text{Ta}_2\text{O}_5$ ,  $\text{TiO}_2$ ,  $\text{ZrO}_2$ , stab-ZrO<sub>2</sub>, CeO<sub>2</sub>, K<sub>2</sub>O, Li<sub>2</sub>O, Na<sub>2</sub>O, Rb<sub>2</sub>O, In<sub>2</sub>O<sub>3</sub>, La<sub>2</sub>O<sub>3</sub>, Sc<sub>2</sub>O<sub>3</sub>, Y<sub>2</sub>O<sub>3</sub>, KNbO<sub>3</sub>, KTaO<sub>3</sub>, BaTiO<sub>3</sub>, CaSnO<sub>3</sub>, CaZrO<sub>3</sub>, CdSnO<sub>3</sub>, SrHfO<sub>3</sub>, SrSnO<sub>3</sub>, SrTiO<sub>3</sub>, YScO<sub>3</sub>, CaHfO<sub>3</sub>, MgCeO<sub>3</sub>, SrCeO<sub>3</sub>, BaCeO<sub>3</sub>, SrZrO<sub>3</sub>, BaZrO<sub>3</sub>, LiGaO<sub>2</sub>, a mixed crystal of LiGaO<sub>2</sub> such as  $(\text{Li}_{1-(x+y)}\text{Na}_x\text{K}_y)(\text{Ga}_{1-z}\text{Al}_z)\text{O}_2$ , or a solid solution containing at least two of them.

12. The semiconductor device as set forth in claim 11, wherein:

a blocking layer constituting the blocking layers is made of  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{AlN}$ ,  $\text{MgO}$ ,  $\text{Ta}_2\text{O}_5$ ,  $\text{TiO}_2$ ,  $\text{ZrO}_2$ , stab-ZrO<sub>2</sub>, CeO<sub>2</sub>, K<sub>2</sub>O, Li<sub>2</sub>O, Na<sub>2</sub>O, Rb<sub>2</sub>O, In<sub>2</sub>O<sub>3</sub>, La<sub>2</sub>O<sub>3</sub>, Sc<sub>2</sub>O<sub>3</sub>, Y<sub>2</sub>O<sub>3</sub>, KNbO<sub>3</sub>, KTaO<sub>3</sub>, BaTiO<sub>3</sub>, CaSnO<sub>3</sub>, CaZrO<sub>3</sub>, CdSnO<sub>3</sub>, SrHfO<sub>3</sub>, SrSnO<sub>3</sub>, SrTiO<sub>3</sub>, YScO<sub>3</sub>, CaHfO<sub>3</sub>, MgCeO<sub>3</sub>, SrCeO<sub>3</sub>, BaCeO<sub>3</sub>, SrZrO<sub>3</sub>, BaZrO<sub>3</sub>, LiGaO<sub>2</sub>, a mixed crystal of LiGaO<sub>2</sub> such as  $(\text{Li}_{1-(x+y)}\text{Na}_x\text{K}_y)(\text{Ga}_{1-z}\text{Al}_z)\text{O}_2$ , or a solid solution containing at least two of them, and

said blocking layer is so provided as to meet the active layer separately from the source electrode, the drain electrode, and the gate insulating layer, each of which serves as a blocking layer.

13. The semiconductor device as set forth in claim 6, further comprising:

a gate electrode for controlling move of a movable electric charge in the active layer;

a gate insulating layer, which serves as a block layer, for insulating the active layer from the gate electrode;

a source electrode connected to the active layer; and

a drain electrode connected to the active layer,

wherein:

at least one of the blocking layers is made of a resin.

14. The semiconductor device as set forth in claim 13, wherein:

a blocking layer constituting the blocking layer is made of a resin, and

said blocking layer is so provided as to meet the active layer separately from the source electrode, the

drain electrode, and the gate insulating layer, each of which serves as a blocking layer.

15. An electronic device, comprising, as a switching element, the semiconductor device as set forth in any one of claims 1 through 4.

16. The electronic device as set forth in claim 15, wherein:

the switching element is connected to a picture element electrode such that an image signal is written in or read out from the picture element electrode.

17. An electronic device, comprising, as a switching element, the semiconductor device as set forth in claim 6.

18. The electronic device as set forth in claim 17, wherein:

the switching element is connected to a picture element electrode such that an image signal is written in or read out from the picture element electrode.

19. An electronic device, comprising, as a switching element, the semiconductor device as set forth in claim 7.

20. The electronic device as set forth in claim 19,  
wherein:

the switching element is connected to a picture  
element electrode such that an image signal is written in  
or read out from the picture element electrode.

21. An electronic device, comprising, as a switching  
element, the semiconductor device as set forth in claim 8.

22. The electronic device as set forth in claim 21,  
wherein:

the switching element is connected to a picture  
element electrode such that an image signal is written in  
or read out from the picture element electrode.

23. An electronic device, comprising, as a switching  
element, the semiconductor device as set forth in claim 9.

24. The electronic device as set forth in claim 23,  
wherein:

the switching element is connected to a picture  
element electrode such that an image signal is written in  
or read out from the picture element electrode.

25. An electronic device, comprising, as a switching

element, the semiconductor device as set forth in claim 10.

26. The electronic device as set forth in claim 25, wherein:

the switching element is connected to a picture element electrode such that an image signal is written in or read out from the picture element electrode.

27. An electronic device, comprising, as a switching element, the semiconductor device as set forth in claim 11.

28. The electronic device as set forth in claim 27, wherein:

the switching element is connected to a picture element electrode such that an image signal is written in or read out from the picture element electrode.

29. An electronic device, comprising, as a switching element, the semiconductor device as set forth in claim 12.

30. The electronic device as set forth in claim 29, wherein:

the switching element is connected to a picture element electrode such that an image signal is written in or read out from the picture element electrode.

31. An electronic device, comprising, as a switching element, the semiconductor device as set forth in claim 13.

32. The electronic device as set forth in claim 31, wherein:

the switching element is connected to a picture element electrode such that an image signal is written in or read out from the picture element electrode.

33. An electronic device, comprising, as a switching element, the semiconductor device as set forth in claim 14.

34. The electronic device as set forth in claim 33, wherein:

the switching element is connected to a picture element electrode such that an image signal is written in or read out from the picture element electrode.